Teaching and Learning to Program: A Qualitative Study of Hong Kong Sub-Degree Students

by

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A thesis submitted for the degree of

Doctor of Education

University of Technology, Sydney

February 2010

Certificate of Originality

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of Candidate

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Acknowledgements

The completion of my doctoral dissertation is a rewarding achievement. It is not only because of the superficial reward but also the underlying process which revealed all the wonder of my Lord's works. As the Bible says, "… all things are working together for good to those who have love for God, and have been marked out by His purpose" (Romans 8:28).

I would like to take this opportunity to express my immense gratitude to everyone who has given their invaluable advice and assistance. In particular, I thank my thesis advisor Dr. Liam Morgan and my former thesis advisor Professor Robert Pithers, who generously devoted their time and knowledge to assist me in throughout my doctoral study.

Special thanks go to my IT colleague, Mr. Gene Chan, who agreed to be one of the two teacher participants of my study. His invaluable teaching experiences in computer programming greatly enriched my data set. Thanks also go to a Taiwanese Professor, Dr. Janet Lin, whom I met over the Internet. Professor Lin accepted my invitation to interview with her at Taipei. She shared her enormous and invaluable teaching experiences in computer programming from elementary to graduate school.

Additionally, I thank my former boss, Dr. Edwin Wong and my present boss, Dr. Wally Fung, who supported my data collection from my students. Without their kind approval, I would not have completed my study.

I offer my appreciation to my colleague and classmate, Ms. Lily Cheung, who helped me recruit students to key in hand-writing transcript data into computer. This greatly reduced my workload in data processing and analysis.

Moreover, special gratitude goes to my wife, Verity Cheng-Yeung, who has given me great support since we started dating in 2002. She made most of the arrangements for our wedding on 7 November, 2009 so that I could spend more time revising my dissertation. I also wish to thank my father, who has always loved me selflessly. He gave me the freedom to choose my studies and career. I also thank my brothers and other family members who supported me in my studies.

I wish to offer my sincere appreciation to my brothers and sisters in Christ, who have devoted their time to pray for and to support me spiritually for many years. My special gratitude goes to Anita Kam-Lau, Orchid Ko-Yu and Anne Chia, who have been giving me unforgettable support in various stages of my life. My thanks also go to Percy Wong, Constance Wong-Ko, Wai-kwong Li, Rica Li-Li, General Cheung, Dicky Cheung-Siu and Joanna Ho-Yeung. I thank those who have prayed for and supported me, even though their names are not listed here.

Any mistakes and omissions in this dissertation are my own.

Give thanks again to the Lord who always comforts me, “My son, my precious child, I love you and I would never leave you. During your times of trial and suffering, when you see only one set of footprints, it was then that I carried you.” (Carolyn Joyce Carty) This thesis is dedicated to Him, the Almighty God.

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Definition of Terms

This section defines the key terms used throughout this dissertation.

Applet: One of the three kinds of Java programs: applets, standalone applications, and servlets. Applets are executed within web pages in client web browsers whereas servlets are executed in web servers.

C: One of the general-purpose programming languages. Some of the syntax in C is similar to that in C++ and Java.

C++: One of the general-purpose programming languages that is an improved extension to C with object-orientation features added.

Closed Laboratory Session: Supervised and scheduled laboratory session.

Compilation: A process that translates a high-level language program into a computer's machine code or some other low-level language (The British Computer Society 2002).

Compiler: A computer program that translates a high-level language program into a computer's machine code or some other low-level language (The British Computer Society 2002).

Confucius (孔子): A Latinised form of the Chinese name Kong Fuzi (孔夫子), Master Kong (551 BC – 479 BC). He was a great thinker and social philosopher whose teachings and philosophy have greatly influenced Chinese and Southeast Asian thought and life (Yao 2000).

Data Variable: A store in a program to hold a data value temporarily.

Eclipse: One of the most popular Integrated Development Environments (IDEs), mainly for developing programs in Java.

The Four Books: Chinese classic texts that Zhu Xi (四書), a great Neo-Confucian (理學), selected as an introduction to Confucianism: *The Great Learning* (大學), *The Doctrine of the Mean* (中庸), *The Analects of Confucius* (論語), and *The Mencius* (孟子). They investigate the fundamental principles of Chinese culture and focus on social and personal affairs (Yao 2000).

HKCEE: Hong Kong Certificate of Education Examination, a public examination taken by a student at the end of his/her five-year secondary education. A Hong Kong student is said to have graduated from secondary education if he/she has got five passes in HKCEE or equivalent.

HKIEd: The Hong Kong Institute of Education.

Integrated Development Environment (IDE): A programming tool which supports both novices and experts in writing programs in a computer programming language.

Intelligent Tutoring System (ITS): Educational software using artificial intelligence. The computer 'learns' from learner/user input and modifies its presentation of material accordingly (Hoven 1997).

Java: A general-purpose programming language. It is an object-oriented programming language that is used in a variety of platforms. Some of the syntax in Java is similar to that in C and C++.

Object-Oriented Programming (OOP): A programming paradigm that supports object technology. It is an evolutionary form of modular programming with more formal rules that allow pieces of software to be reused and interchanged among programs. OOP is thought to increase productivity by allowing programmers to focus on higher-level software objects (Intrinsyc Software 2001).

Paired Programming: A practice in which two programmers work collaboratively at one computer to generate program designs, algorithms, or program codes.

Program Analysis: The (automated) inspection of a program to infer some property. Program analysis is needed for most kinds of program transformation and can range from simple local properties in pattern matching to more complicated global properties in dead code elimination (Van Deursen 2001b).

Program Comprehension: The process of acquiring knowledge about a computer program (Georgia Tech 2001).

Program Statement: Basic construct of a program to present an instruction that will be executed to perform an action or a part of it.

Program Visualisation: Using graphics to make a program more understandable. It differs from Visual Programming, where the program is created graphically; in program visualisation, it is created in the normal, textual manner and the graphics are used afterwards to show how it works (Myers & Maulsby 2001).

SCPE: School of Continuing and Professional Education, one of the academic units of the Hong Kong Institute of Education.

Software Visualisation: The use of computer graphics and animation to illustrate and present computer programs, processes, and algorithms. Teachers can use software visualisation systems to help students understand how algorithms work, and they can be used in program development to help programmers understand their code better (Van Deursen 2001a).

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Abstract

This study investigates the experiences of the Hong Kong sub-degree students in learning computer programming and explores ways to help the students learn more effectively.

In Hong Kong, sub-degree programs are offered to increase the number of students studying post-secondary education. The performance of the sub-degree students is weaker than that of undergraduate students. Learning computer programming is a challenge for most post-secondary students and especially for sub-degree students. A considerable amount of research has been done in teaching and learning programming in the last decade. However, most of this research was targeted to Western undergraduates. The findings of this research might not be applicable to Chinese students or to the weaker Hong Kong sub-degree students. This study attempts to fill this gap.

A theory-seeking case study research is conducted to investigate students' learning of programming. The researcher collected and analysed data from semi-structured interviews. Other data sources – active participant observations, reflective memos, and analysis of students' programming assignments and examination – are used to triangulate the data from the interviews.

The grounded theory that emerged, the theory of 'Performance Improvement of Programming', offers an exploratory insight into the experiences of the Hong Kong sub-degree students in learning to program. It addresses the distinctive challenges

facing Hong Kong students in learning, learning styles, and strategies. This study also suggests practical strategies in light of the students' characteristics in order to assist their learning of programming.